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# ARM®

# INNOVATION

SPRING 2002

## SOLVING COMPLEXITY

### New tool delivers multi-core, mixed architecture debugging and OS awareness

As manufacturers of electronic products incorporate ever greater functionality into their creations, so ARM silicon Partners need to design microprocessors which are increasingly more complex. Add to this the need to develop products quickly and to reduce development costs, and the importance of a new debugging tool from ARM becomes clear.

The ARM RealView™ Debugger was launched at the Embedded Systems Conference in San Francisco in March. The product complements existing ARM debugging technology and provides an 'Operating System-aware', multi-core debugger for systems based on multiple ARM cores as well as mixed architecture designs that use an ARM core plus a DSP core.

The ARM RealView Debugger is the first debugger to allow a truly synchronized, high-integrity debug for multiple ARM and DSP cores. It uses a single kernel for multi-core debugging and is based on Mentor Graphics' embedded technology. OS awareness includes Symbian, ThreadX, and Nucleus. Support for additional DSPs and OS is planned.

ARM's product manager of debug tools, Lester Perera, said that the launch of the RealView Debugger marks the start of a new family of highly-optimized tools for the ARM architecture. "We have taken into account the complexity and intricacies of our designs and used this knowledge to develop the most advanced tools possible," he said.

"By enabling developers to debug multiple cores simultaneously, the RealView Debugger gives a completely accurate picture, in real-time, of the interaction within complex SoC designs that enables problems to be solved a lot faster."

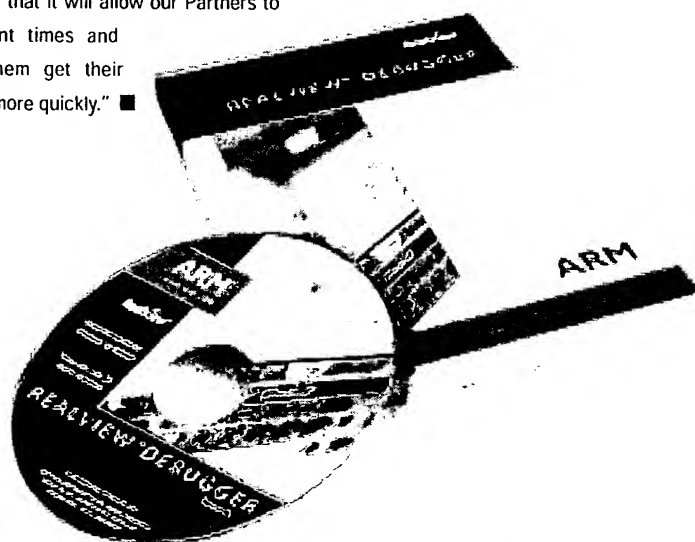
"RealView tools provide designers with the best solution for creating and analyzing systems based on ARM technology. And the RealView Debugger is no exception," said Lester. "All ARM RealView tools are designed and used by the creators of the ARM architecture, so they enable the highest level of pre-silicon evaluation and development, and the broadest range of support for future architecture families and derivatives."

The launch of RealView Debugger generated considerable interest among delegates at the Embedded Systems Conference. David Lamie, COO and vice president of Sales, Express Logic, commented: "Constant innovation is key to moving technology forward and ARM has demonstrated its commitment to providing high-quality solutions with the launch of the RealView Debugger."

He continued: "The added value that this product will bring to ARM core-based devices, including the ThreadX operating system, is that it will allow our Partners to reduce development times and costs and help them get their products to market more quickly." ■

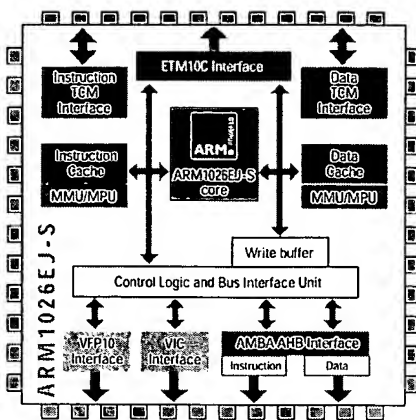
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# ADVANCING THE ARM ARCHITECTURE

## ARM announces next generation microarchitecture and ARM1026EJ-S™ processor core



On April 30, 2002, at the Embedded Processor Forum in San Jose, ARM unveiled details of the ARM11™ microarchitecture and the ARM1026EJ-S™ core.

Complementing the ARM9™ and ARM10™ microarchitectures, the ARM11 microarchitecture is the first implementation of the ARMv6 instruction set architecture (announced in October 2001) and will form the basis of a new range of ARM11 CPU products.

The ARM11 microarchitecture is ideally suited to next generation wireless and consumer devices, particularly those applications which require high levels of system performance and low power consumption. These include 2.5G and 3G mobile phone handsets; PDAs and multimedia wireless devices; home consumer applications, such as set-top boxes; and high-end printers and digital cameras.

The ARM11 microarchitecture targets performance ranges of 400 to 1,200 Dhrystone MIPS, and will deliver 350 to 500+ MHz on 0.13µm foundry processes, and over 1 GHz on next-generation 0.1µm processes, while meeting the low power needs and cost requirements of battery operated and high density embedded applications.

It is designed to address the requirements of real-time applications, advanced operating systems and multimedia, such as audio and video coding and decoding. Silicon based on the ARM11 microarchitecture is expected to be available from ARM Partners in Q2 2003.

"System developers demand continual innovation to enable the creation of world class digital products," said John Rayfield, director of R&D, ARM. "The ARM11 microarchitecture is the foundation of our next generation of CPU cores, and delivers new levels of performance and efficiency for leading-edge wireless and consumer devices."

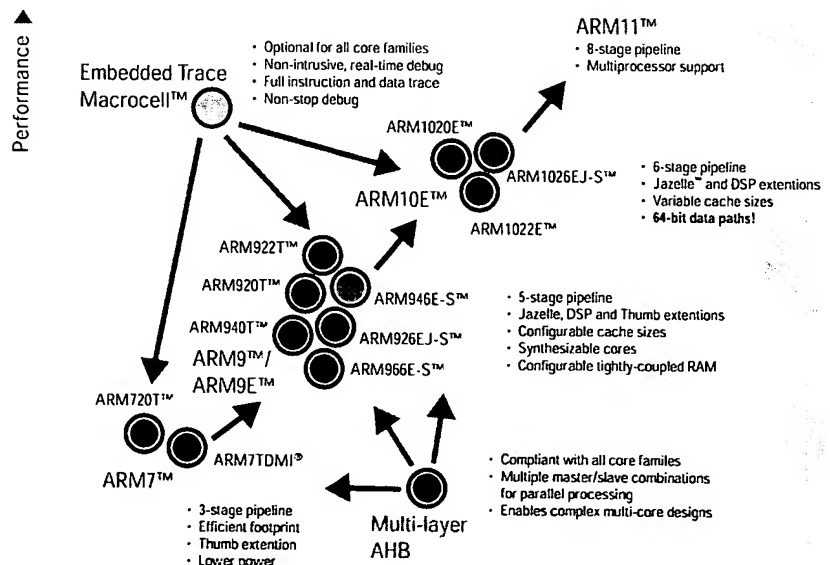
Also unveiled at the Embedded Processor Forum was the ARM1026EJ-S processor core. Developed at the ARM Austin Design Center, it is the second generation product from the ARM high performance ARM10E microprocessor core family, and implements the ARMv5TEJ architecture.

This core improves on the ARM1020E™ and ARM1022E™ cores by bringing many of the most popular features of the ARM926EJ-S core into the ARM10E family. The ARM1026EJ-S core is a synthesizable core with configurable cache and TCM sizes. It also includes ARM's Jazelle™ technology — introduced in the ARM926EJ-S core — for the execution of Java™ byte codes in hardware, thus dramatically improving the performance of Java programs.

Many of the original features of the ARM10E family continue to offer a performance edge to systems based on the ARM1026EJ-S core. The static branch prediction logic of its predecessors has been further optimized and a Return Prediction Stack has been added for even greater performance.

All ARM10E family processors include 64-bit bussing which further improves the core's performance, especially when accessing memory-resident data. The ARM1026EJ-S core has 64-bit buses at its AHB interfaces, from AHB to the caches and TCM's, and from the caches and TCM's to the core register file. With its 64-bit AMBA™ Multi-layer AHB interface, the ARM1026EJ-S core has code and data bandwidth unmatched by any previous ARM core.

The ARM1026EJ-S solution also includes the ARM10E family's high performance coprocessor interface, which can transfer data to and from a coprocessor — like the VFP10 IEEE 754-compatible Vector Floating Point coprocessor — 64 bits at a time and supports the execution of a coprocessor instruction every clock cycle. ■



Architecture evolution ►



## LIFE IN 3D

Tom Cronk speaks on ARM alliances delivering richer content for cell phone users

A decade ago, the standard cell phone was about the size and weight of a brick. The ability to make and receive calls on the move was a revelation, yet there was little the device could do beyond this basic functionality.

Rapid technology developments — of both the handset and the network — have vastly increased the capabilities of the cell phone while also reducing the size and weight of the device. ARM and its Partners have played an important role in turning the cell phone into an essential component of modern living. The majority of the world's cell phones are ARM Powered\* and now, with a series of new developments and third-party agreements, ARM is set to play a pivotal role in the next stage of evolution.

"Network operators worldwide have invested heavily in 2.5G and 3G networks — in the form of news and information services, games, multimedia messaging, navigation information, etc.," said Dr. Tom Cronk, Director, Wireless, ARM.

"All of these new services significantly enhance the potential to increase the average revenue per user (ARPU). To achieve them, however, improvements are needed both in the capabilities of the handset and the download mechanisms which deliver the content to the handset."

Already cell phones with color displays are being shipped and high-performance ARM processors are being utilized to run more complex graphics, including games and 3D screen savers. Many forthcoming handsets are being developed using ARM Jazelle technology which enables fast and power-efficient Java execution, which is another key element in the delivery of rich content.

In the quest to promote standardized and efficient download mechanisms for interactive 3D content, ARM has formed a partnership with Superscape to develop a 3D software rendering engine for mobile

phones, a key element of the new interactive 3D applications platform, Swerve.

Dr. Mike Grant, VP, Marketing and Strategy at Superscape said: "As the power behind wireless 3D, the ARM core-optimized Swerve platform offers manufacturers, operators and content developers the power to create and deliver a wide range of entirely new and compelling wireless applications. We strongly believe that those applications will very quickly make a major contribution to increasing industry revenues from both 2.5G and 3G wireless data services."

High-quality graphics and compact file sizes are prerequisites in the mobile communications environment. But there must also be improvements in the performance of the handset to deliver advanced graphical games and other functions. This requires the addition of 3D acceleration in the chipset.

To this end, ARM has formed a partnership with Imagination Technologies to provide 3D acceleration that is suitable for the mobile environment. Under the joint development agreement announced in 2001, the ARM MBX graphics cores based on PowerVR\* technology from Imagination will be integrated alongside ARM microprocessor cores in applications for the mobile phone, PDA, digital set-top box, Internet appliance, portable games console and automotive infotainment markets.

"The combination of these technologies will enable the next generation of mobile devices to approach the advanced graphic capabilities of PCs and games consoles, thus giving users a compelling reason to upgrade their handsets and take advantage of the new content rich services," said Dr. Cronk. "The only losers will be outdated cell phones which, like their already obsolete predecessors, are destined to become museum exhibits of the future." □



Superscape  
[www.superscape.com](http://www.superscape.com)

Imagination Technologies  
[www.imgtec.com](http://www.imgtec.com)

## MULTIMEDIA ON THE MOVE

ARM MOVE™ technology doubles video codec performance

Through partnerships with specialist companies like Emblaze Systems and PacketVideo Corporation, and its MOVE™ technology, ARM is playing a central role in supporting development of next generation multimedia products.

The ARM MOVE technology consists of a set of highly optimized software and hardware components designed to act as building blocks for the development of multimedia products. For example, the MOVE technology enables video encoding at up to twice the speed of existing encoders. MOVE technology provides the building blocks for the development of a wide range of products, such as wireless videophones, digital cameras, portable audio players and handheld games.

Any product that needs to efficiently encode or decode music, video, still images, or the human voice could benefit from ARM MOVE technology. The technology is aimed mainly at wireless or handheld devices with limited facilities and processing power. But as it is developed further, additional performance and functionality will allow the support of larger and more detailed video images, for devices with greater physical capabilities, such as video tablets or digital TV.

A number of areas of new functionality are under consideration, such as support for photo-realistic video which could be used to create moving avatars and realistic animated graphics for gaming. Support for many new codecs such as MP3 Pro, GSM-AMR etc, are also being examined. ■

 packetvideo

  
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## MOVING BEYOND THE CORE: MAKE THE CONNECTION

ARM extends its messaging and brand beyond the microprocessor core

To many people, ARM excels at designing microprocessor cores. This is perfectly understandable since ARM is the leader in providing 32-bit RISC microprocessor IP. The

proliferation of ARM Powered™ logos on countless end-user products is testament alone to the broad adoption of ARM technology. Now ARM is moving beyond the core in both product offering and market positioning.

"While the mainstay of our business is still built around providing microprocessor core IP, we now provide a complete end-to-end solution" says Erik Ploof, Director of Corporate Identity for ARM. "Together with our Partners, we are able to provide all the essential building blocks for designing and manufacturing SoC solutions based on the ARM architecture. This includes a broad choice of microprocessor cores, a full complement of development tools, and system platforms that integrate hardware and software optimized for specific applications. This architecture provides a proven blueprint for developing ARM core-based products in practically every embedded market".

"In the construction industry, an architecture provides a blueprint for moving from concept to form through an integration of required components, i.e. structure, ergonomics, color, etc." Ploof explains. "In the embedded world, we provide a blueprint that integrates required

components too, except our components are technologies such as microprocessor cores, design tools and software.

*"Together with our Partners, we are able to provide all the essential building blocks for designing and manufacturing SoC solutions based on the ARM architecture."*

We have structured our key brands for these required components. For example, we have created the RealView brand for our entire line of development systems and tools. RealView is the parent brand for all ARM Development Systems products, positioning a broad variety

of products under one brand name with one promise — to provide best-in-class tools and the greatest insight into how a partner's solution is interfacing with the ARM Architecture. In the coming months we will do the same for the other key components."

ARM is also working with key Partners to increase awareness of the sheer size and breadth of the ARM Partner Network. Providing the largest Partner Network in the industry, with more than 90 silicon partners alone, ARM offers the highest attainable choice and compatibility in the embedded space today.

The company has made significant progress toward its goal of making ARM synonymous with its pledge of providing a complete architecture for the embedded market — the Architecture for the Digital World™. Through their strong brand program, they are well on their way to achieving it. ■

ARM  Architecture

# XSCALE™ ACCELERATION

## Intel® XScale™ developers benefit from ARM RealView™ tools development experience

Thanks to a new range of software development and debug tools from ARM, developers working with the Intel® XScale™ microarchitecture will be able to produce increasingly innovative and efficient designs

while also accelerating time-to-market. Benefiting from all of the knowledge that has made the ARM Developer Suite™ a favoured product in the industry, this new suite of tools provides an out-of-the-box solution, tailored specifically for Intel XScale developers and, backed by both ARM and Intel. According to ARM product manager, Gordon

Stubberfield, this is good news for companies which are incorporating the XScale microarchitecture into handheld, wireless, networking and storage products.

"We have worked closely with Intel to support the development of the ARM architecture-compliant, Intel XScale technology," said Gordon. "Our in-depth understanding of the architecture means that ARM can provide the highest quality code generation and debug tools. The new range of tools brings together all necessary elements for rapid and cost-efficient development of systems and solutions that use Intel XScale technology-based processors."

The tool kit, which is marketed under the ARM RealView brand, includes C and C++ compilers; a macro-assembler and linker for processors based on the Intel XScale technology; the AXD debugger with support for on-chip trace capability; a JTAG debug interface; and a version of the ARM Firmware Suite™ that includes support for developer boards. The ARM and Thumb® C and Embedded C++ (EC++) compilers provided in this Developer Kit are recognized by the industry as providing the best performance of all available ARM targeting compilers.

ARM's relationship with Intel can be traced back to 1995. The partnership was strengthened in July 2001, when the two companies announced that they had signed a licensing agreement, extending Intel's existing license to include the next generation, high-

performance, low-power ARMv6 architecture. In licensing ARMv6, Intel gained the base technology from which it could expand on and advance its XScale microarchitecture.

*"Our in-depth understanding of the architecture means that ARM can provide the highest quality code generation and debug tools."*

At the time of this announcement, Peter Green, general manager of Intel's Handheld Computing Group said: "The wide adoption of the ARM architecture allows Intel to offer advanced processing capabilities to the networking and communications market segments. The new licensing agreement provides Intel with a strong foundation upon which we can continue to build innovative features for Intel XScale products."

ARM's Stubberfield says that the availability of ARM tools for the XScale microarchitecture is the next logical step in the relationship. "Developers now have access to a full range of software development and debug tools designed specifically to meet the needs of XScale technology," he said.

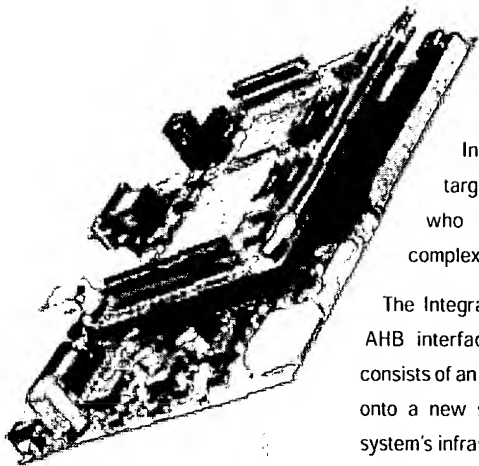
"As with all RealView products, quality is ensured because all debuggers, code generators, physical and virtual platforms within the suite take full advantage of the unique attributes of the ARM architecture and are designed, and used, by ARM engineers. For this reason, RealView tools enable the highest level of pre-silicon evaluation and development as well as the broadest range of support for future ARM architectural families and derivatives."

Few people would doubt the logic of this argument. Time-to-market is everything in the technology industry and buying tools from the people who designed the core ensures you stay one step ahead of the competition who have to wait for third-party tools suppliers to catch up. □



## COMPACT INTEGRATION

To achieve the highest levels of confidence in the final silicon, developers need to prototype designs in an environment similar to the final system. This principle has guided the development of ARM's Integrator<sup>®</sup> test chip-based platforms.



The most recent addition to the Integrator family is ideally suited for developers who need a lower cost, smaller form factor SoC development platform for prototyping. The Integrator<sup>®</sup>/CP (Compact Platform) is also targeted at software development engineers who require a target platform without the complexity of a full Integrator system.

The Integrator/CP solution provides a lighter weight AHB interface for single processor applications. It consists of an ARM920<sup>™</sup> (non-ETM) Core Module mounted onto a new smaller platform board that provides the system's infrastructure and connectors for the I/O.

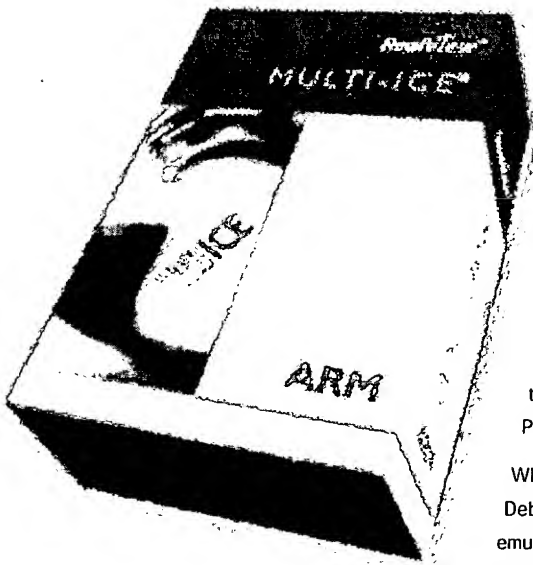
The FPGA on the Core Module is reprogrammed to support AHB Lite, a new SDRAM controller and PrimeCell<sup>®</sup> Peripherals for the following:

- UARTs
- Keyboard and Mouse
- Real-Time Clock
- Multi Media Card
- Colour LCD
- Audio Codec Interface

The Integrator/CP board also supports an Ethernet interface chip and Flash memory, as well as it can also support two Integrator/LM solutions plugged on top of the Core Module.

Initially shipped as a complete system consisting of the Core Module, Platform Board and power supply ready-loaded with the PrimeCell Peripherals and AFS, the Integrator/CP board is available now, with other variants — such as the ARM946E<sup>™</sup>, ARM966E<sup>™</sup> and ARM926EJ-S<sup>™</sup> cores — to be released during the second half of 2002. □

## EVEN COOLER THAN MULTI-ICE<sup>®</sup>



ARM's popular JTAG-based In-Circuit Emulator, Multi-ICE<sup>®</sup> unit, which provides unequalled support for all ARM core-based devices which contain the Embedded-ICE<sup>™</sup> logic, has undergone a major update.

The new version, Multi-ICE<sup>®</sup> 2.2, supports all new revisions of existing ARM cores as well as the new ARM926EJ-S<sup>™</sup> core and the ARM architecture-compliant Intel<sup>®</sup> XScale<sup>™</sup> technology-based cores, the IOP321, the PXA210, and the PXA250 cores.

When used in conjunction with Trace Debug Tools v1.2, the Multi-ICE 2.2 emulator supports real-time trace of the Intel XScale technology through its on-chip

trace buffer. The new version also offers customized visibility and debug of peripheral registers, support for Microsoft<sup>®</sup> Windows<sup>®</sup> CE.NET Platform Builder and includes the RealMonitor<sup>™</sup> target debug agent for the debug of running targets.

ARM develops Multi-ICE emulator support for all new ARM cores during the design and validation phases, ensuring that the Multi-ICE emulator supports all the features of the new cores. JTAG emulation allows the core to be stopped and started under the control of the connected debugger software. The user can then examine and modify registers and memory, and set breakpoints and watchpoints.

The ARM Multi-ICE 2.2 emulator and the ARM Trace Debug Tools v1.2 solution are now available from ARM and distributors of ARM development tools. □

## AMBA™ COMPLIANCE PROGRAM

Since it was originally launched in 1995, the AMBA specification for on-chip interface and interconnect has been downloaded from ARM's website by more than 2,000 design engineers and successfully implemented in hundreds of ASIC designs.

As a technology independent interface, the AMBA specification enables the reusability of peripheral and system macrocells across a wide range of applications. The AMBA Compliance Program has been created to provide a means of testing IP against the AMBA specification to improve confidence in the use of third party IP and stimulate the market for its development.

The AMBA Compliance Program provides the focal point of ARM's commitment to maintaining and promoting the benefits of AMBA standards. AMBA Compliance is awarded when a component is demonstrated to have been exercised with sufficient transactions to achieve sufficient coverage without violating any AMBA protocol rules.

By claiming AMBA Compliance, IP developers are entitled to use the 'AMBA Compliant' trademark in association with their IP, thereby giving confidence to customers that the component will seamlessly integrate with other AMBA-compliant components in SoC designs.

ARM's AMBA Compliance Testbench (ACT) enables developers of IP components to demonstrate that the testing of the AMBA interface has achieved a predefined quality level. ACT will be available in the second half of 2002.

For more information about the AMBA specification, the AMBA Compliance Program and ACT, please visit [www.arm.com](http://www.arm.com). □



## AUTOMOTIVE SECTOR DRIVES AHEAD

On March 6th 2002, the ARM automotive team hosted the second annual ARM in Automotive Conference (AAC) in Stuttgart, Germany. ARM hosts AACs in different regions all over the world, as a vehicle to educate OEMs and developers of ARM core-based automotive designs, as well as to create a forum for automotive professionals to network.

The AAC was attended by ARM OEMs, Partners and Third Parties, including representation from a broad range of vehicle manufactures, module OEMs and semiconductor vendors including Hynix, Philips, Sharp and ST Microelectronics.

The full day event was filled with presentations on a variety of subjects related to the current automotive market. These included, body controller SoC design integration; scalable telematic/infotainment systems; NextGen CAN protocol (Bosch); TTP on ARM core-based ASSPs (TTTech); SoC platforms (AIEC); and OSEK/ORTI (ETAS). □

## ALTERA AND ARM UNITE WITH EXCALIBUR PRODUCTS

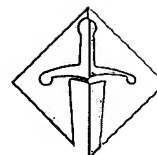
San Jose-based Altera Corporation is the world's pioneer of system-on-a-programmable-chip (SOPC) solutions. In March 2002, Altera announced the availability of its complete range of Excalibur™ embedded processor solutions based on high-performance ARM processor cores. With this announcement, Altera consolidates its leadership in programmable logic innovation by providing embedded system designers with an integrated (hard-core) subsystem on a PLD.

This implementation optimizes the performance of the processor core and its associated peripherals, and enhances applications that require high-speed computing capabilities alongside advanced, high-performance programmable logic. Designers can boot the system in a processor-centric mode and dynamically configure the programmable logic. As a result, designers do not have to spend time, or consume logic elements, building the subsystem themselves. Altera's SOPC Builder system level design tool, in concert with the Quartus II development software, increases productivity by automating much of the system integration aspects of the design flow.

ARM core-based Excalibur devices embed an ARM922T™ processor core and offer over 200 MIPS performance. All Excalibur devices also implement the associated caches, memory management unit, on-board SRAM and dual-port RAM, external memory interfaces, standard peripherals, AHB and interfaces to the logic portion of the device. This allows designers to customize the desired intellectual property (IP) functionality onto the PLD and rapidly prototype designs on a single device. Excalibur products also enable customers to enter low-to-mid volume production with the same single-chip devices.

Many communications, industrial and other high-end consumer applications require high performance and integrated functionality, yet must also realize the cost and time-to-market demands of their products' markets. The ARM core-based Excalibur device family excels at this balancing act. □

[www.altera.com](http://www.altera.com)



EXCALIBUR™



# INNOVATION

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## ARM TRAINING

### Taiwan

- ARM System Design, Taipei, Taiwan, 25-28 June
- Hardware Design with Foundry Program Macrocells, Taipei, Taiwan, 30-31 July

### UK

- ARM Hardware Design, Cambridge, UK, 16-18 July
- ARM Software Design, Cambridge, UK, 11-13 June
- ARM System Design, Cambridge, UK, 2-5 July, or 13-16 August

### USA

- ARM926EJ-S System Design, Austin, TX, USA, 23-26 July
- ARM Software Design, Los Gatos, CA, USA, 18-20 June or Austin, TX, USA, 9-11 July, or 20-22 August
- Hardware Design with Foundry Program Macrocells, Los Gatos, CA, USA, 25-26 June

To register for a course or to check out the most up-to-date ARM training schedule, please visit: <http://www.arm.com/arm/training>.

## EVENTS DIARY

### June

- ARM Seminar, Tokyo, Japan, 6 June
- Cambridge Technology Exchange, Cambridge, UK, 11-12 June
- ARM Networking Conference, San Jose, CA, USA, 18 June
- ESEC, Tokyo, Japan, 26-28 June

### July

- Wireless 2002, Tokyo, Japan, 17-19 July

For more information on events where you can find ARM, please visit: <http://www.arm.com/news/events>.

## ARM TECHNICAL PUBLICATIONS

### New releases

- |               |   |
|---------------|---|
| ARM DDI 0249A | ARM PrimeCell External Bus Interface (PLEBI)                        |
| ARM DDI 0238A | VFP9-S Vector Floating-point Coprocessor Technical Reference Manual |
| ARM DUI 0159A | Integrator CP Compact Platform User Guide                           |
| ARM DII 0046A | MBX 3D Graphics Core Version 1 Software Integration Guide           |

### Updates

- |               |   |
|---------------|---|
| ARM DDI 0242B | Embedded Trace Buffer Technical Reference Manual        |
| ARM DDI 0177B | ARM1020E Technical Reference Manual                     |
| ARM DDI 0213C | ARM966E-S (Rev 2) Technical Reference Manual            |
| ARM DUI 0048F | Multi-ICE version 2.2 User Guide                        |
| ARM DUI 0154B | Multi-ICE version 2.2 TapOp Reference Guide             |
| ARM DSI 0005G | Multi-ICE version 2.2 Installation Guide                |
| ARM DSI 0011E | ARM Firmware Suite v1.4 Installation Guide              |
| ARM DUI 0102F | ARM Firmware Suite version 1.4 Reference Guide          |
| ARM DUI 0136C | ARM Firmware Suite version 1.4 User Guide               |
| ARM DDI 0213C | Errata01 — ARM966E-S (Rev 2) Technical Reference Manual |

For more technical publication information from ARM, please visit: <http://www.arm.com/arm/documentation?OpenDocument>

## PARTNER NEWS



Broadcom to incorporate the ARM926EJ-S core into next-generation products (7 May 2002)



LSI Logic Becomes First ARM Partner To License Synthesizable ARM1026EJ-S Core (1 May 2002)



ARM, Imagination Technologies and Superscape Collaborate To Deliver Seamless 3D User Experiences On Wireless Devices (11 April 2002)



Philips and ARM Announce First High Performance 32-bit RISC-based standard Embedded Controller using 0.18 Micron Flash Process (13 March 2002)



ARM and UMC Expand Foundry Program Alliance (12 March 2002)



ARM Introduces the RealView Developer Kit for Processors Based on the Intel® XScale™ Technology (26 Feb 2002)



Sanyo Licenses ARM PrimeXsys Wireless Platform For Wireless Multimedia ASICs (20 Feb 2002)



Hantro Broadens Product Range With ARM MOVE Technology (19 Feb 2002)

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